

Handwriting Fluency in Kindergarten: Exploring the issue of time

by

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Curriculum-based measures (CBM) are necessary for educators to quickly assess student skill levels and monitor progress. This study examined the use of the alphabet fluency task, a CBM of writing which assesses how well children access, retrieve, and write letter forms automatically. The alphabet fluency task was administered at both the beginning and end of the kindergarten school year. Scores were collected at two time points, 15 seconds and 60 seconds. Alphabet fluency scores at both points were compared to criterion measures of writing—standardized writing assessments and compositional CBM of writing. Results indicate that although measures at both 15 and 60 seconds are valid, measures at 60 seconds are more valid in assessing handwriting fluency of kindergarten students at both the beginning and end of kindergarten. Future applications of this task and further areas of study are discussed.

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1.0 INTRODUCTION

Literacy, the ability to read, write, and speak English at adequate levels of proficiency is necessary to successfully function in school, on the job and in society (Snow, Burns, & Griffin, 1998). Yet, in 2007, the Nation's Report Card revealed that 65% of eighth graders and 75% of twelfth graders were performing below proficient in writing (Salahu-Din, Persky, & Miller, 2008). Children with early learning difficulties in areas related to literacy continue to experience problems with reading and writing throughout school and into adulthood (Bruck, Hulme, & Malatesha, 1998; Felton, 1998). Therefore, it is imperative to assess and identify problems with writing from the very early grades before deficits become stable and resistant to intervention efforts. The primary purpose of the present study is to examine a measure of handwriting fluency, a transcription skill that is considered important to the writing process, at the kindergarten level.

1.1 CONSTRAINTS ON WRITING

A longitudinal study of students from first through fourth grade showed that students who are poor writers at the end of first grade remain poor writers through fourth grade (Juel, 1988). Researchers have since been studying what differentiates good writers from poor writers (e.g., Berninger, 2009; Wagner et al., 2011). Through a review of current research, Berninger (1999)

examined constraints on students' development of compositional skills. Two crucial processes were identified in elementary school children: text generation and transcription. Text generation is a higher-level process in which ideas are translated into language representations in memory (Berninger et al., 1992). Children are able to generate ideas for writing by generalizing oral language; however, they must learn new processes to transcribe the mental representations into written language. Research has shown that developing writers have a larger number of ideas of what they would like to write than what they are able to physically produce (Hayes & Berninger, 2009). Their ability to write down their many ideas is constrained by lack of fluency in transcription skills.

Transcription is a lower-level component writing skill that is necessary for children to produce written language (Berninger et al., 1992). This skill enables the complete translation of language representations in memory to representations in writing form. Berninger et al. (1992) researched the relationship between the lower-level skill of handwriting and the higher-level skill of composition with first, second, and third grade students. They showed that both lower-level developmental skills (e.g., alphabet letter production, orthographic coding, orthographic-phonological mapping, neuromotor function, and visual-motor integration) and the lower-level component writing skill of transcription provide a critical foundation in the beginning stages of writing. The development of these skills affects the degree to which higher-level composition skills will eventually be achieved in subsequent stages of writing development (Berninger et al., 1992). Therefore, as shown in Figure 1, transcription is a foundational component of text generation at all levels from sub-word to discourse (Berninger et al., 1992).

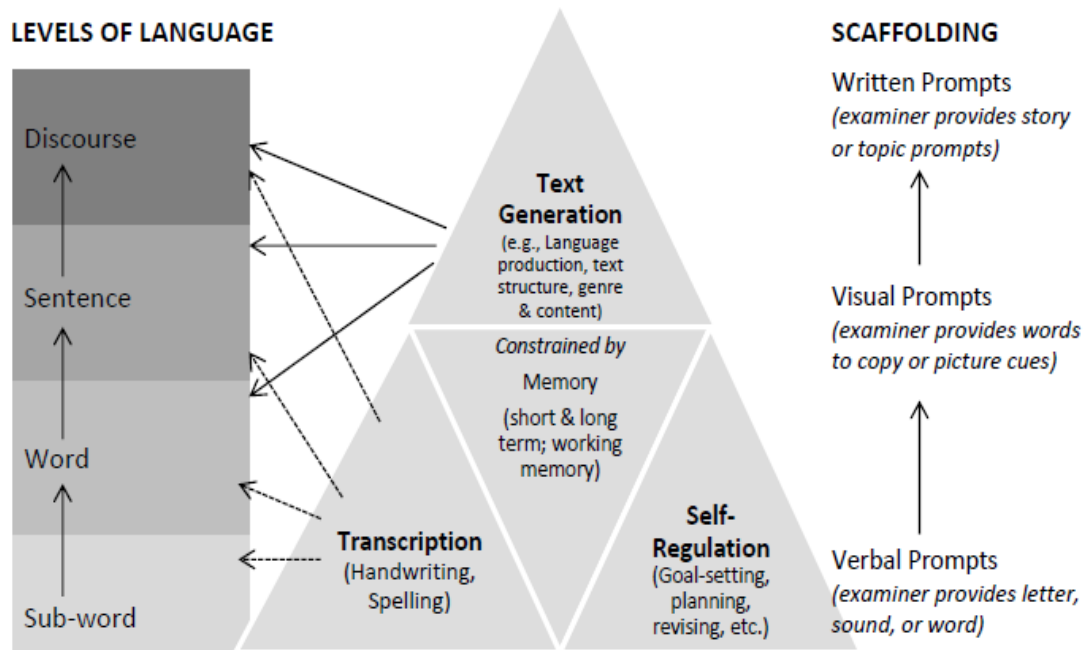


Figure 1: Constraints on text generation: memory, transcription, self-regulation.

Reproduced from “Fluency Metrics in Education: Implications for Test Developers, Researchers, and Practitioners” by Ritchey, K.D., McMaster, K.L., Al Otaiba, S., Puranik, C.S., Kim, Y-S., & Parker, in-press, New York: Springer.

Transcription has two separable components, handwriting fluency and spelling, both requiring a great deal of cognitive and physical effort for a child in the developmental stages of writing (Berninger, 1999). As students develop transcription skills, they are able to devote less effort to maintaining letter forms in working memory (McCutchen, 2000). Rather, they are able to use this capacity for higher-level processes needed to improve composition. The present study looks specifically at the handwriting fluency component of transcription.

1.2 HANDWRITING FLUENCY

Fluency, how quickly and accurately a task can be completed, is considered an important component of good reading skills. Fluency in reading is generally assessed by having children read letter names, produce letter sounds, or read single words as quickly and accurately as they can in a specified period of time. In curriculum-based reading measures such as the Dynamic Indicators of Basic Early Literacy Skills (DIBELS; Good & Kaminski, 2002), children are shown a page with letters, words, or nonsense words and are required to produce letter names, segment letter sounds, or read the words and nonsense words as quickly and accurately as possible in a given time frame. A similar measure is the Academic Improvement Measurement System (AIMSWeb; Howe & Shinn, 2002) which includes typed narratives that children read as quickly as possible. Similar to fluency in reading, as already indicated, fluency in writing is also considered an important ingredient.

Handwriting fluency refers to how well children access, retrieve, and write the letters of the alphabet reliably and automatically (Berninger & Fuller, 1992). Throughout the literature, this fluency is referred to by a variety of names including orthographic fluency, alphabet fluency, and letter writing fluency. For the purposes of this study, handwriting fluency will be used in reference to how quickly and accurately children can access and produce letter forms. Alphabet fluency will be used in reference to specific tasks involving writing the alphabet. Therefore, alphabet fluency tasks express handwriting fluency skills.

A vast body of research indicates that handwriting writing fluency constrains children's ability to compose text. This constraint begins as early as kindergarten (Puranik & Al Otaiba, 2012) and continues through ninth grade (Graham, Berninger, Weintraub, & Schafer, 1998). Furthermore, Berninger et al. (1997) have shown that training in handwriting fluency transfers to

an increase in compositional fluency, as studied with first grade students. Therefore, beginning writing instruction should focus not only on teaching the formation of alphabet letters and high-level composition skills but also on automatization of the retrieval and production of alphabet letters.

1.3 CURRICULUM-BASED MEASURES

To assess writing and other skills such as math or oral language, educators primarily can choose between two types of assessment: standardized tests and curriculum-based measures (CBM). Standardized assessments are often chosen because their psychometric properties have been tested extensively and they allow for comparison of performance among same-aged peers. These psychometric properties include validity and reliability. However, standardized assessments have several functional disadvantages (Gansle et al., 2004). They are typically administered to students individually and take a long time to instruct and complete. Most importantly, they do not allow for periodic progress monitoring. Yet, despite the individual nature of standardized tests, administrators must follow very specific protocols to retain their high validity and reliability. Therefore, these tests cannot be adapted to various student needs (Jenkins, Deno, & Mirkin, 1979). Because of the great amount of time and monetary resources required, as well as the inability to adapt to individual students, educators look to other forms of student assessment (Gansle, Noell, VanDerHeyden, Naquin, & Slider, 2002).

CBM provide alternatives to standardized testing. They have an added advantage in that they can be used to monitor student progress in specific academic areas (Parker, McMaster, Medhanie, & Silberglitt, 2011). CBM are used by educators to quickly assess students and

determine students' abilities to perform specific skills. The majority of CBM do not have the established population norms like standardized assessments; however, school districts have the ability to generate their own norms. (Deno, 2003). CBM are also very functional. They can often be given to all students in a class at the same time, are typically shorter as they are created to assess a more specific set of skills, and can be better adapted to students' needs (Deno, 2003). After two decades of research, useful and appropriate CBM are available to assess reading skills (McMaster, Ritchey, & Lembke, 2011). However, adequate CBM of writing, especially for students in the early phases of acquiring writing skills, lack the research necessary to be recommended for use by educators.

1.4 ASSESSMENT OF HANDWRITING FLUENCY

In studies with elementary school children, various CBM of handwriting fluency have been used, including assessment of writing at narrative, sentence, and sub-word levels. A task at the narrative level with first, second, and third grade students involves students copying as much of a short story as possible in 90 seconds (Berninger et al., 1992). A similar task used at the sentence level with first graders is the sentence-copy task in which students copy as many sentences as possible within one minute (Parker et al., 2011). Handwriting fluency at the sub-word (i.e., letter) level generally involves children writing the alphabet from memory. Olinghouse and Graham (2009) provided students, second and fourth graders, with 60 seconds and instructed them to write the letters of the alphabet from memory as many times as possible. A similar task, known as the alphabet fluency task, has been used in many studies researching handwriting fluency (e.g., Berninger, 1992; Berninger, 1999). In this task, children write lowercase letters of

the alphabet as quickly and accurately as they can in 15 seconds. Berninger and Rutberg (1992) utilized this task in a study with first, second, and third grade students and discovered a strong correlation between the alphabet writing task and all criterion writing measures (handwriting, spelling, and composition). They concluded that the alphabet task as measured in 15 seconds has concurrent validity for assessing beginning writing. This task has been adapted for kindergarten students by allowing students 60 seconds to write the alphabet rather than 15 seconds (Kim et al., 2011). There is no consensus regarding the use of a time-frame—15 seconds versus 60 seconds to examine handwriting fluency. Whereas 15 seconds may be appropriate for older elementary school children, 60 seconds may be more appropriate for kindergarten children given their relatively young age and developmental levels.

2.0 PURPOSE OF PRESENT STUDY

The purpose of the present study is to examine a CBM of handwriting fluency. This CBM, the alphabet fluency task, was administered at the beginning and end of kindergarten. Results at both times of assessment will be analyzed. Two alphabet fluency scores were determined, one within 15 seconds of writing and one within 60 seconds of writing. To explore which time indication is a more useful and appropriate measure for the kindergarten level, alphabet fluency scores will be compared to criterion measures of writing. The criterion measures used in this study include standardized writing assessments and CBM that assess composition abilities at sentence and narrative levels. The following research questions will be investigated: 1) Are alphabet fluency scores at 15 seconds and 60 seconds both valid measures of alphabet fluency? 2) Which time increment is a more valid measure of handwriting at the beginning of kindergarten? 3) Which time increment is a more valid measure of handwriting fluency at the end of kindergarten?

2.1 HYPOTHESIS

Current research supports the use of 15 seconds in the alphabet fluency task (e.g., Berninger & Rutberg, 1992). However, this research has been conducted with students in first grade or above. Developmental differences between kindergarten and first grade students have not been a focus

of prior research. It is predicted that students' abilities of skills required for fluent writing such as memory and fine motor control have a greater effect on writing in kindergarten than on writing in first grade and above. To address these differences and allow for a more accurate measurement of handwriting fluency, it is predicted that alphabet fluency scores will be more valid at 60 seconds. This hypothesis holds for both beginning and end of year assessment.

3.0 METHODS

3.1 PARTICIPANTS

Participants for this study were 134 kindergarten students. Data for these students were collected as part of a larger intervention study aimed at improving writing skills for kindergarten children. The participants were recruited from eight kindergarten classes in four public and charter elementary schools in the Pittsburgh area. Parental consent was obtained for all students. The schools were selected to represent a range of socioeconomic status (SES) backgrounds. Two schools were low-SES, one school was mid-SES, and one was a university laboratory school. There were comparable numbers of males (53%) and females (47%). The age of the students, as recorded at the beginning of kindergarten, ranged from 5 years, 2 months, to 6 years, 5 months. The average age was 5 years, 9 months ($SD = 4$ months). Demographic information about the participants is provided in Table 1.

Table 1: Demographic information of participants

Mean age (<i>SD</i>)	5; 9 (4)
Age range (years; months)	5; 2 - 6; 5
Gender	
Female	63 (47%)
Male	71 (53%)
Ethnicity	
White	55 (41%)
Black	58 (43%)
Hispanic	4 (3%)
Asian	6 (5%)
Other	11 (8%)

3.2 PROCEDURES

Data on multiple CBM of writing were collected as part of the larger study. These measures were administered by trained research assistants (RAs). Administration of all CBM took place in the students' regular classrooms with all students in attendance participating. Approximately 60 minutes were dedicated to instruction and completion of the CBM battery. The CBM were always given in the same testing order. Data from three of the CBM (i.e., the alphabet fluency task, the sentence writing task, the essay task) given at the beginning and end of the school year are used in the current study.

A standardized test battery was also administered by trained RAs. Tests were given to students individually in quiet rooms. These tests included the Test of Early Written Language, Third Edition (TEWL-3) basic and contextual writing subtests (Hresko, Herron, Peak, & Hicks, 2012), the Woodcock-Johnson III spelling subtest (Woodcock, McGrew, & Mather, 2007), and

three subtests from the Dynamic Indicators of Basic Early Literacy Skills (DIBELS, Good & Kaminski, 2002). Completion of the individual test battery took approximately 60 minutes. Individual testing did not occur the same day as group testing; however, both were conducted within a span of three weeks. Assessments were administered in pre-determined orders, varying randomly between students, to counterbalance ordering effects. Only data from the TEWL-3 basic subtest and WJ-III spelling subtest are reported in the current study.

3.3 MEASURES

3.3.1 Alphabet Fluency Task

The alphabet fluency task was part of the CBM battery of five group-administered assessments given to each of the eight classes at both the beginning and end of kindergarten. All students in each class (except those absent on days of testing) were simultaneously given the alphabet fluency task. The students were provided lined paper and pencils without erasers. The lead RA provided group instructions to students and several RAs were present to assist and monitor each class. Before beginning the task, students were instructed verbally and provided a visual example. They were told to write the lowercase letters of the alphabet as fast and as carefully as possible until told to stop. Students were instructed to cross out any mistakes they made and continue writing. After instruction, dividers were placed between students to ensure they were working independently and were not copying from each other. The students were told to begin and the lead administrator started a timer. After 15 seconds of writing, the students were told to stop and raise their pencils above their heads. Research assistants then marked each student's

paper with a line or stamp after the last letter written by the student. Once each child's paper had been marked, the students were instructed to continue writing the lowercase letters of the alphabet from where they had stopped at the 15-second mark. After 45 more seconds (a total of 60 seconds of writing), the students were again instructed to stop writing and each paper was marked after the last letter written. The students were then instructed to finish writing the rest of the alphabet as fast and as carefully as possible. There were no more stopping points and the students continued to write the alphabet until completed or until they were unable to continue due to lack of letter knowledge. Papers were collected when students indicated they had finished writing.

3.3.2 Standardized Measures

Two standardized measures of writing were used in this study, the TEWL-3 basic subtest and the WJ-III spelling subtest. The TEWL-3 basic subtest assesses writing abilities at multiple levels (Hresko et al., 2012). Students are initially instructed to execute simple tasks that express lower-level literacy skills such as holding a pencil and tracing a letter. Instructions increase with difficulty and lead to tasks based on composition such as sentence combining and part of speech classification. Assessors are trained to cease questioning when a student misses five consecutive questions. Scores on the TEWL-3 express students' general writing abilities and allow for comparison among same-age peers.

The second standardized measure used in this study is the WJ-III spelling subtest (Woodcock et al., 2007). This assessment measures skills related to spelling. Students are first instructed to copy shapes such as lines and squiggles. They are then instructed to produce specified letters and finally words. Again, this assessment increases in difficulty and testing is

concluded when a student is unable to write correct responses to 6 consecutive questions. Scores obtained from the WJ-III spelling subtest express students' abilities to copy forms, produce letters, and write correctly-spelled words.

3.3.3 Composition Measures

In addition to the main subject of this study, the alphabet fluency task, data from two other CBM of writing are included in this study. Both measures chosen were administered to all students in a given class simultaneously. A lead RA administered instructions and presented examples, then monitored students along with several other RAs.

The first measure chosen was the sentence writing task. This task is a measure of students' ability to compose text at the sentence level. In this task, students were provided with two sheets of lined paper and pencils without erasers. Each paper also contained two picture-word prompts. All picture-word prompts included a small graphic of a three or four letter word and the typed word underneath. Students were instructed to generate sentences based on the picture and include the typed word in their sentences. Students were given 5 minutes to write. If a student finished writing on the first page, he or she was prompted to continue onto the next page and keep writing until time was finished. After 5 minutes, students were instructed to stop writing. Research assistants then asked each student to read what he or she had written. Each response was written beneath the student's writing.

The second compositional measure chosen was the essay task. This task is a measure of students' ability to compose text at the narrative level. Students were provided with a sheet of lined paper and an eraser-less pencil. Each paper included the essay prompt, "I like kindergarten because..." The lead RA explained the prompt to students and had students generate possible

ideas to write about. Students were given 5 minutes to write. If they stopped before the end of the time, RAs prompted students to continue writing for the remainder of the 5 minute period. After 5 minutes, students were instructed to stop writing. Research assistants asked each student to read his or her essay and copied the student's response onto his or her paper.

3.3.4 Scoring

When scoring the alphabet fluency task, each letter written by the student was evaluated and scored. Scores were given to represent the accuracy of letters written. Individual letters received a score of 0 points, 0.5 points, or 1 point. Coders made scoring judgments based on four possible types of errors: formation/control, reversal/inversion, uppercase, unrecognizable. Letters without any of the listed errors were given 1 point. Letters with only one formation/control, reversal/inversion, or uppercase error were given 0.5 points. Scores of 0 points were given to letters with multiple errors or letters that were unrecognizable. Letters in random order (i.e., not in an alphabetical sequence of at least two letters) were designated as uncodable and did not receive a score. Final scores were calculated by adding the number of points received. Two final scores were calculated: one score of letters written in 15 seconds, one score of letters written in 60 seconds.

The TEWL-3 was scored during testing by the RA test administrator. Responses to instructions were deemed as either correct or incorrect. Correct responses received a score of 1 point while incorrect responses received a score of 0 points. Responses to a few specified instructions at the composition level received scores of 0, 1, 2, or 3 points depending on the extent to which instructions were deemed fully executed and correct. When a student received 5 consecutive scores of 0, the test was concluded.

The WJ-III spelling subtest was also scored by a RA during testing. All responses received a score of 0 or 1 point(s) dependent upon correctness of response. After 6 consecutive scores of 0, the test was ended.

The compositional measures, the sentence writing and essay tasks, were scored in four ways: the number of words written (WW), the number of words spelled correctly (WSC), the number of words in a correct two-word sequence (CWS), and correct punctuation (PUC). Only WW and WSC are used for analysis in the present study.

3.3.5 Inter-rater Reliability

Each alphabet fluency task was coded and scored by two RAs. These RAs were provided a scoring rubric with corresponding examples and received coding training. Each assessment was coded by both RAs separately. Differences in scoring were discussed and a final score agreed upon by both RAs was determined and entered. Inter-rater reliability of letter correctness scoring across all classes was 88%.

Compositional CBM were also scored by two RAs independently. As with the alphabet fluency task, RAs were trained and utilized scoring rubrics and examples. Disagreements in scoring were discussed and final scores were entered. For the sentence writing task, inter-rater reliability for WSC was 83%. Inter-rater reliability for WSC of the essay task was 94%. All standardized measures were double-entered into separate spreadsheets, compared, and compiled into one checked and agreed-upon dataset to ensure each score was entered correctly.

4.0 RESULTS

Analyses were aimed at investigating the relationship between handwriting fluency as assessed through the use of the alphabet fluency task at two time points. This task was scored twice, once within 15 seconds and once within 60 seconds. These scores were compared to criterion writing measures (standardized assessments and compositional CBM). Significance of Pearson r correlations and magnitudes of differences between correlation coefficients were the primary methods of comparison. Distributions of scores were also compared.

4.1 HANDWRITING FLUENCY AT THE BEGINNING OF KINDERGARTEN

Descriptive statistics for the assessment measures at the beginning of kindergarten are shown in Table 2. The alphabet fluency scores within 15 seconds ranged from 0-17 letters with a mean of 1.54 ($SD = 1.94$). Thirty-five of the 134 students (26.1%) assessed received a score of 0. Only four students received a score of 5 or greater. Within 60 seconds, the variability of scores was wider, ranging from 0-23.5 letters. Twenty-six students (19.4%) received a score of 0. Sixty students (44.8%) received a score of 5 or greater. Distributions of alphabet fluency scores at the beginning of kindergarten in both 15 and 60 seconds are shown in Figure 2.

Table 2: Psychometric properties of variables at the beginning of kindergarten

Variable	<i>M</i>	<i>SD</i>	Range	Skew	Kurtosis
Alphabet fluency					
15 seconds	1.54	1.94	0-17	4.14	29.34
60 seconds	4.75	4.28	0-23.5	1.45	3.18
WJ-III spelling	103.27	14.21	58-134	-0.28	0.38
TEWL-3 basic	104.75	10.79	85-129	0.39	-0.47
Sentence writing					
Words written	4.98	6.38	0-22	1.02	-0.21
Words spelled correctly	3.59	4.75	0-19	1.22	0.52
Essay					
Words written	3.89	7.07	0-36	2.28	5.53
Words spelled correctly	2.54	5.14	0-31	2.99	10.56

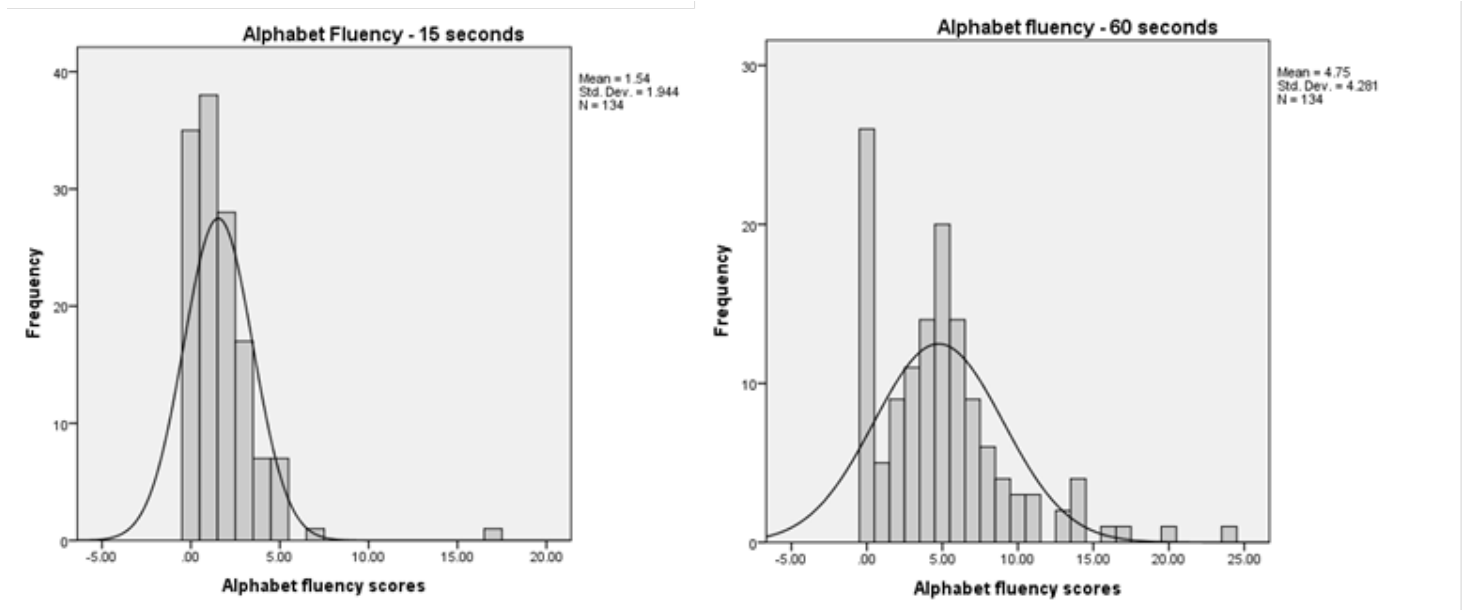


Figure 2: Distributions of alphabet fluency scores at the beginning of kindergarten

Correlation coefficients, as determined by Pearson r correlation testing, of alphabet fluency scores to criterion measures of writing are displayed in Table 3. Results at the beginning of kindergarten showed that the alphabet fluency measure at 15 seconds was significantly correlated with all criterion measures of writing except WJ-III Spelling ($p > .01$).

Alphabet fluency scores at 60 seconds also showed significant correlations with all other writing measures. These correlations were stronger than the corresponding correlations with scores obtained in 15 seconds. Table 3 also shows the magnitudes of differences between the correlation coefficients obtained at 15 seconds and the correlation coefficients obtained at 60 seconds. These results indicate statistically significant differences between correlations of alphabet fluency scores and criterion measures at 15 seconds and those at 60 seconds for all measures.

Table 3: Correlations of alphabet fluency to criterion writing measures and corresponding magnitudes (p values)

Criterion measure	Alphabet fluency					
	Beginning of kindergarten			End of kindergarten		
	15 seconds	60 seconds	magnitude (p values)	15 seconds	60 seconds	magnitude (p values)
WJ-III spelling	.25	.43*	.001*	.35*	.39*	.28
TEWL-3 basic	.27*	.56*	.001*	.40*	.46*	.19
Sentence writing						
Words written	.40*	.64*	.001*	.45*	.60*	.001*
Words spelled correctly	.50*	.68*	.001*	.48*	.65*	.002*
Essay						
Words written	.44*	.63*	.001*	.48*	.65*	.001*
Words spelled correctly	.53*	.65*	.002*	.48*	.62*	.001*

Note. *Comparisons significant at $p < .01$.

4.2 HANDWRITING FLUENCY AT THE END OF KINDERGARTEN

Descriptive statistics for the assessment measures at the end of kindergarten are shown in Table 4. The alphabet fluency task within 15 seconds at the beginning of kindergarten had a mean of 3.47 ($SD = 2.34$). Less than 10% of students received a score of 0. Forty-one of 134 students (30.6%) received a score of 5 or greater. Within 60 seconds, the mean increased from the beginning of kindergarten ($M = 10.42$, $SD = 6.44$). Less than 4% of students received a score of 0. Scores of 5 or greater were received by 80% of students. Distributions of alphabet fluency scores at the end of kindergarten in both 15 and 60 seconds are shown in Figure 3.

Table 4: Psychometric properties of variables at the end of kindergarten

Variable	<i>M</i>	<i>SD</i>	Range	Skew	Kurtosis
Alphabet fluency					
15 seconds	3.47	2.34	0-10	0.55	-0.01
60 seconds	10.42	6.44	0-25.5	0.48	-0.53
WJ-III spelling	107.75	12.55	83-135	0.03	-0.34
TEWL-3 basic	115.08	11.33	81-140	-0.56	0.48
Sentence writing					
Words written	11.32	7.03	0-34	-0.17	-0.35
Words spelled correctly	8.99	5.93	0-29	0.10	-0.13
Essay					
Words written	9.22	9.85	0-46	0.99	0.88
Words spelled correctly	6.31	7.08	0-37	1.29	2.33

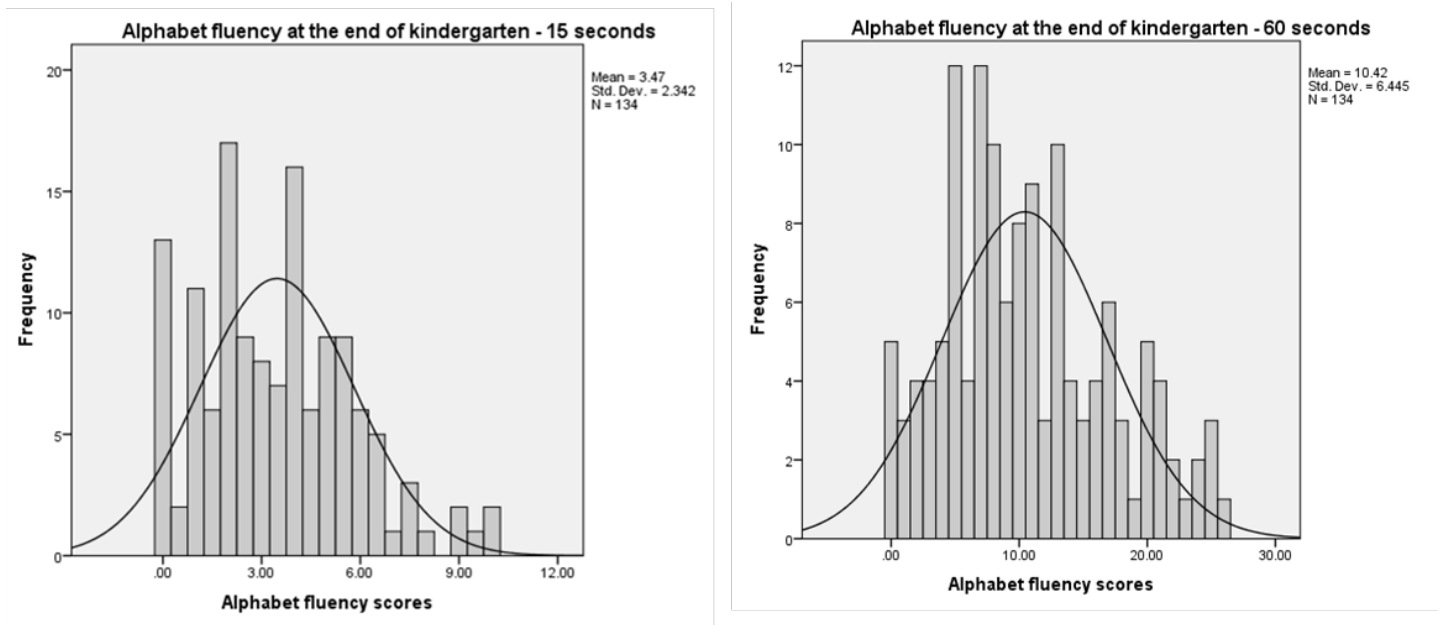


Figure 3: Distributions of alphabet fluency scores at the end of kindergarten

Correlations of alphabet fluency scores to criterion measures of writing at the end of kindergarten are also shown in Table 3. These results showed that the alphabet fluency measure at 15 seconds was significantly correlated with all criterion measures of writing ($p < .01$). The alphabet fluency scores at 60 seconds also correlated significantly with all criterion measures. Magnitudes of the differences in correlations between scores within 15 seconds and scores within 60 seconds were significant for the compositional CBM. Magnitudes of the correlations between alphabet fluency scores and the standardized measures of assessment, WJ-III Spelling and TEWL-3 Basic, were not significantly different.

5.0 DISCUSSION

Transcription, involving handwriting fluency and spelling, is a component of writing that affects composition of text at all levels of language. Handwriting fluency develops as students become familiar with producing letter forms and are able to maintain them in long-term memory. As this familiarity increases, working memory can be used for text generation, rather than specific letter forms. Another aspect of handwriting fluency is the physical act of writing letters. As students learn and develop the physical ability to write letters, their speed and ease of writing increases. With this development, handwriting becomes less constraining to writers.

Kindergarten has become a grade in which writing instruction is a main focus. Yet, very little research of writing development at the kindergarten level is available. Research has primarily focused on older students, specifically first, second, and third graders (e.g., Berninger, 1992, Berninger, 1992, Berninger, 1999). However, the findings of this research cannot be generalized to the kindergarten level for a variety of reasons. It is likely that most kindergarten students are not performing at the same developmental level as most first, second, and third grade students. They may be at different developmental levels of fine motor skills, memory, and letter knowledge.

This study was conducted to evaluate a task used to measure handwriting fluency: the alphabet fluency task. This task, when used with students in first grade and above, requires students to write the lowercase letters of the alphabet as quickly and carefully as possible. In

most studies where this task is used, the task is concluded after a period of 15 seconds. The letters written in this 15-second period are scored and used to determine students' handwriting fluency abilities and later measure growth and progress.

Based on the differences between kindergarten and older elementary students, it was predicted that 15 seconds may not be an appropriate amount of time to assess kindergarten students' handwriting fluency. An alternate amount of time, 60 seconds, was proposed.

Correlations between alphabet fluency scores and criterion measures of writing (both standardized and compositional CBM) were analyzed to determine which timing distinction, 15 seconds or 60 seconds, is a better measure at the kindergarten level. The magnitudes of the differences between these correlations were also investigated.

5.1 HANDWRITING FLUENCY AT THE BEGINNING OF KINDERGARTEN

CBM are typically designed to allow educators to quickly assess and determine student ability levels of specific skills. The alphabet fluency task is no different. It is designed to enable teachers to assess student handwriting fluency abilities within a few minutes. Educators must also be able to quickly interpret results to determine students' levels of performance and identify struggling students. Although standardized population norms have not been established, a normal distribution of scores is still useful. If a normal distribution cannot be formed because of wide variability of scores, comparisons of the student scores to the mean score are not functional. Educators are left with an idea of student skills but no useful methods of comparison among students.

In this study, the majority of kindergarten students were not able to produce many letters within 15 seconds at the beginning of the year. On average, students wrote less than 2 letters during this time period. The standard deviation was high showing wide variability of scores. The distribution of scores showed a large range with high skewness and high kurtosis. Many students were not able to write a single letter and therefore received scores of 0. The distribution of scores within 15 seconds was not normal.

On the other hand, scores within 60 seconds had a mean of 4.75. Skewness and kurtosis were much less significant at 60 seconds. A significant number of students had scores of 0, resulting in a large standard deviation; however, this distribution of scores is close to a curve of normal distribution. Therefore, student scores are better able to be compared and levels of proficiency can be determined.

As exhibited by the large number of students scoring 0, many students enter kindergarten without any prior knowledge of letter writing. When conducted at the beginning of the year, this measure is skewed at both 15 and 60 seconds because of the difference between students with letter writing knowledge and students without. For even those students who have prior letter writing knowledge, it is likely that letter forms are still very difficult to access and produce under timed conditions. Fifteen seconds is not a long enough time for students to complete this process, resulting in a low mean score for the number of letters written. To fully observe students' baseline handwriting fluency abilities at the beginning of kindergarten, it is useful to allow students time to express their knowledge. Fluency is a measure of how quickly this can be expressed; however, scores of 0 because of a too short time period do not access handwriting fluency abilities. Rather, they may express difficulties with task processing, organization, and

fine motor movement. Handwriting skills may be better expressed when students are given 60 seconds to complete this task.

The stronger validity of the 60-second measure at the beginning of kindergarten can be observed through the correlations between all criterion measures of writing, both standardized and compositional. At 15 seconds, correlations are significant for all criterion measures except the WJ-III spelling subtest. However, the correlations between 60 seconds and all standard and compositional measures used are significantly higher. Therefore, both the 15-second and 60-second measures have concurrent validity with most criterion measures of writing, but the 60-second measure has stronger validity with these measures.

The 60-second measure is more valid because of its higher correlations with criterion measures, both standardized and compositional. These relationships occur because of how handwriting fluency affects the skills needed for the other measures at the beginning of kindergarten. The TEWL-3 assesses various aspects of writing skills. Because handwriting fluency constrains these writing skills, those students who score high on standardized tests should also score high on the alphabet fluency task. Because these tasks are more significantly correlated at 60 seconds, it follows that the 60-second alphabet fluency measure is better able to show students' skills. At the beginning of kindergarten, handwriting fluency is also highly related to scores on the WJ-III spelling subtest, showing the constraining effect of handwriting fluency at the word level.

The 60-second measure is also more significantly correlated with both sentence writing (WW and WSC) and the essay task (WW and WSC). This significance shows that the alphabet fluency task at 60 seconds is a better indicator of compositional skills. Because 15 seconds only allows most students the time to write a few letters, these low scores may not express the full

range of the students' abilities and show a weak correlation with related writing skills of composition. Giving students enough time to access and produce a higher number of letters provides a better indication of how much text they are able to compose at both sentence and narrative levels.

Relationships between the alphabet fluency task and criterion measures of writing indicate that handwriting fluency constrains writing at all levels (i.e., sub-word, word, sentence, and narrative) at the beginning of kindergarten. Students with strong handwriting fluency abilities are likely to perform well on handwriting fluency measures, standardized writing assessments, and compositional CBM.

5.2 HANDWRITING FLUENCY AT THE END OF KINDERGARTEN

At the end of kindergarten, students have likely received a large amount of writing instruction. However, 15 seconds is still a very short time period to express writing skills. At 15 seconds, the mean score has only increased to 3.47. The skewness and kurtosis of the scores are lower. About 10% of students still received scores of 0. A normal distribution can be approximated; however, the low mean and wide standard deviation within a small range of scores make useful comparisons among students difficult to obtain.

Within 60 seconds, the mean alphabet fluency score increased to 10.42. The standard deviation ($SD = 6.44$) is still high; however, scores resemble a normal distribution. Despite a high standard deviation, this effect is lessened due to a wider range and comparisons can be made among student scores. Less than 4% of students received a score of 0. Scores of 10 or more were received by 55% of the students tested.

The correlations between 15 seconds and 60 seconds and the other measures of writing used in this study were all statistically significant at the end of the year. Therefore, both measures show concurrent validity with criterion measures of writing. However, similar to scores at the beginning of kindergarten, the correlations between 60 seconds and the criterion measures of writing were more significant.

The magnitudes of the differences in the correlations at 15 and 60 seconds were significant for compositional measures of writing only. Because students have progressed throughout the year, handwriting fluency may now be less constraining to the skills required for the standardized assessments used in this study. The TEWL-3 assesses multiple writing skills from lower to higher-levels. Because the correlation between the alphabet fluency task and this assessment is weak, handwriting fluency appears to be less constraining to the general abilities tested by the TEWL-3 at the end of kindergarten. Handwriting fluency also appears to be less constraining to spelling at the end of kindergarten, as tested with the WJ-III spelling subtest.

However, handwriting fluency scores at the end of kindergarten are highly correlated with compositional measures of writing. This is consistent with prior research which indicates that handwriting fluency is highly correlated with writing at the sentence and narrative levels (e.g., Berninger, 1999; Berninger et al., 1997). Handwriting fluency is constraining to composition generation at both the sentence and narrative level at both the beginning and end of kindergarten.

Students on average show great increases in writing abilities from the beginning of kindergarten to the end of kindergarten. This is shown through both handwriting fluency and compositional abilities. To best assess handwriting fluency at the kindergarten level, the alphabet fluency task in 60 seconds is recommended. Educators can use this task to determine

baseline levels of handwriting fluency, monitor progress, and assess end of year growth. Although this task shows concurrent validity with criterion measures within 15 seconds as well, this relationship is more significant when the task is conducted within 60 seconds.

5.3 IMPLICATIONS

The results of this study show that the alphabet fluency task is a more valid measure of handwriting fluency of kindergarten students when given in 60 seconds than when given in 15 seconds. Educators of kindergarten students can use this CBM to assess and compare students' skill levels at the beginning and end of the kindergarten school year. They can also implement the alphabet fluency task as a form of progress monitoring. Educators can track scores of the alphabet fluency task throughout the year to show student growth and development. This task can be administered and scored quickly; therefore, this task will not be invasive or detrimental to kindergarten education.

The alphabet fluency task within 60 seconds can also be used to identify students who are struggling with writing. At the beginning of the year, many students will not be able to write anything. However, as the year progresses, writing improvements should be shown. If the alphabet fluency task is used to monitor progress, students who are not improving will be very visible. Teachers can then implement an intervention or increase instruction to assist struggling students. This task will help identify the students who struggle with handwriting fluency and allow educators to provide assistance and support before those struggles prevent compositional development as well.

5.4 LIMITATIONS AND FURTHER DIRECTIONS

The results of this study were determined primarily by calculation of correlations. Further statistical analysis is necessary to solidify the results found. Also, this study did not address reliability of the alphabet fluency task or its predictive power. Again, further statistical analysis is needed to examine these aspects.

This study is also limited in the variables that were surveyed or controlled. Students enter kindergarten with various backgrounds that may or may not include previous schooling such as preschool programs. Whether students had previously attended preschool, daycare, or educational classes was not surveyed for the purposes of this study. Home experiences and interactions are also crucial components of child development. Home experiences involving literacy can have a large impact on a student's writing development. The amount and variety of these home literacy experiences were not surveyed in the present study either. Whether or not these differences effect the development of handwriting fluency would be an interesting extension of this project.

Another area of further research could compare 15 seconds and 60 seconds at the elementary level. Strong correlations between the alphabet fluency task in 15 seconds and criterion measures of writing have been found (e.g., Berninger & Rutberg, 1992). However, a study comparing alphabet fluency scores within 15 seconds and 60 seconds has not been completed. If the 15-second measure were shown to be more valid when used with older students, a study could then evaluate the differences between students at the end of kindergarten and students in first grade or above. This evaluation could include studying developmental differences such as memory, self-regulation, fine motor control, and other skills utilized during writing acquisition.

A larger extension of this study could explore how handwriting fluency affects later writing development. It is known that handwriting fluency is correlated with compositional writing. However, this research has primarily focused on elementary and secondary students. Yet, studies link handwriting fluency with achievement in education at the collegiate level as well (Connelly, Campbell, MacLean, & Barnes, 2006). A more in-depth study of this relationship throughout all levels of education may provide an even stronger context for emphasis on writing instruction at the kindergarten level.

6.0 CONCLUSION

This study examined the alphabet fluency task, a measure of handwriting fluency. Results show that this task is more useful and appropriate at the kindergarten level when scored within 60 seconds. These results are maintained at both the beginning of kindergarten and the end of kindergarten. Educators can utilize this task to establish baselines, monitor progress, and assess end of year levels.

The original research questions have been addressed. Both the 15-second alphabet fluency task and 60-second alphabet fluency task are valid measures of handwriting fluency. However, the 60-second alphabet fluency task has stronger concurrent validity with criterion measures of writing including standardized assessments and compositional CBM. Alphabet fluency scores determined within 60 seconds provide meaningful scores that express students' abilities to access, retrieve and write letter forms automatically, more so than scores determined within 15 seconds. The alphabet fluency task can be used to identify students who are experiencing difficulties with writing development. These students can then receive the additional instruction and/or intervention they need to promote success in kindergarten, in society, and throughout the rest of their lives.

APPENDIX A

CBM AT THE BEGINNING OF KINDERGARTEN

This appendix provides examples of CBM collected at the beginning of kindergarten. All examples were obtained from different students. The first CBM (A.1) is an example of the alphabet fluency task. Students were instructed to write the alphabet as quickly and carefully as possible. After 15 seconds, students were instructed to stop writing and an administrator placed the first stamp. Students were again instructed to write and a second stamp was placed after a total of 60 seconds of writing. Students then continued writing the alphabet until completed or unable to continue. A final stamp was placed after each student indicated that he or she was finished writing.

The second CBM shown (A.2) is an example of the sentence writing task collected at the beginning of kindergarten. Students were given 5 minutes to write as many sentences as possible. Prior to the task, students were instructed to write on the first page and continue onto the second page if time remained. There were no instructions pertaining to how many sentences students should write for each picture; however, each picture has two corresponding lines. After students finished writing, RAs asked each student to read what he or she had written and wrote it underneath the corresponding student writing.

The third CBM (A.3) is an essay task sample. Students were instructed to write as much as possible about why they like kindergarten. Students were given two sheets and instructed to continue to the second sheet if they filled out the first. In the example below, the student wrote only on the first page. Research assistants asked each student to read what he or she had written and wrote it on the students' paper.

A.1 ALPHABET FLUENCY TASK

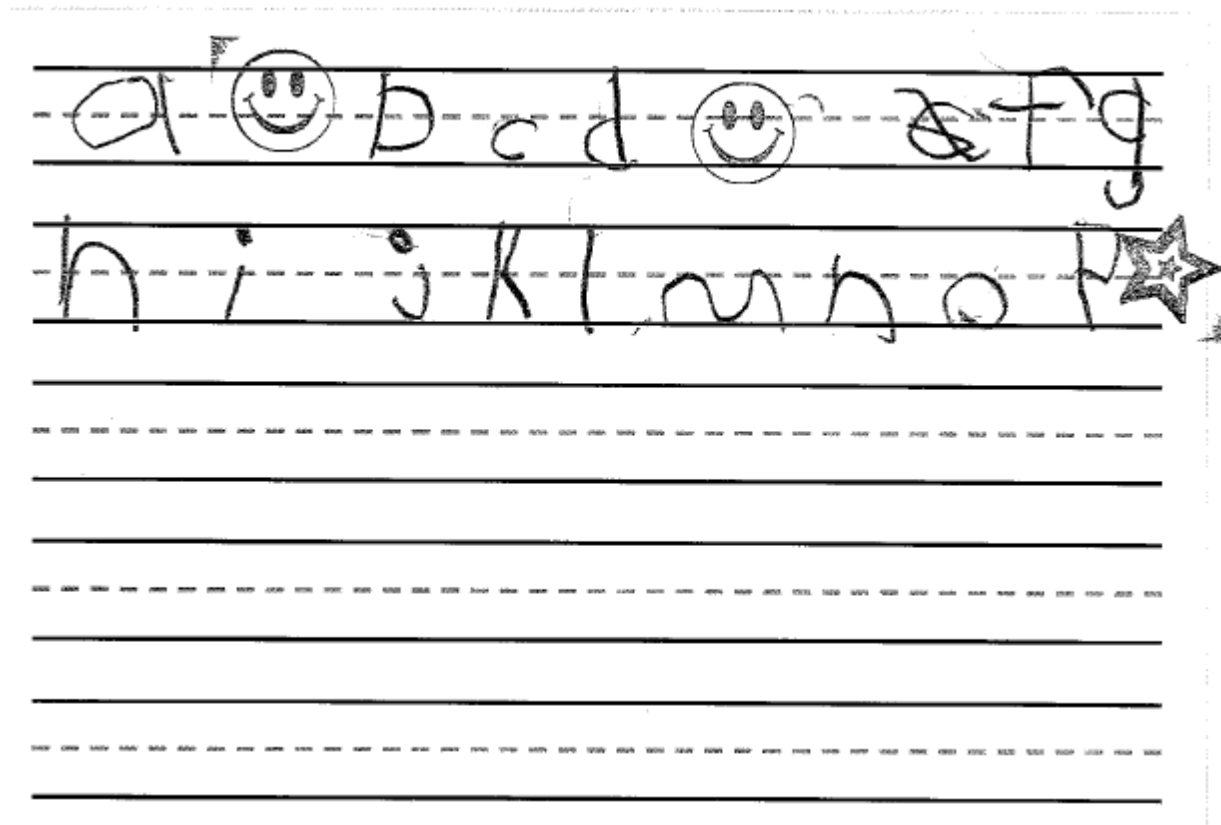


Figure 4: Alphabet fluency task example at the beginning of kindergarten

A.2 SENTENCE WRITING TASK



I LIKE A FOX.


I Like a fox.



I LIKE TO DRINK FROM A MUG.

I like to drink from a mug.

Figure 5: Sentence writing task example at the beginning of kindergarten



eat

eat



sock

Figure 6: Sentence writing task example (page 2) at the beginning of kindergarten

A.3 ESSAY TASK

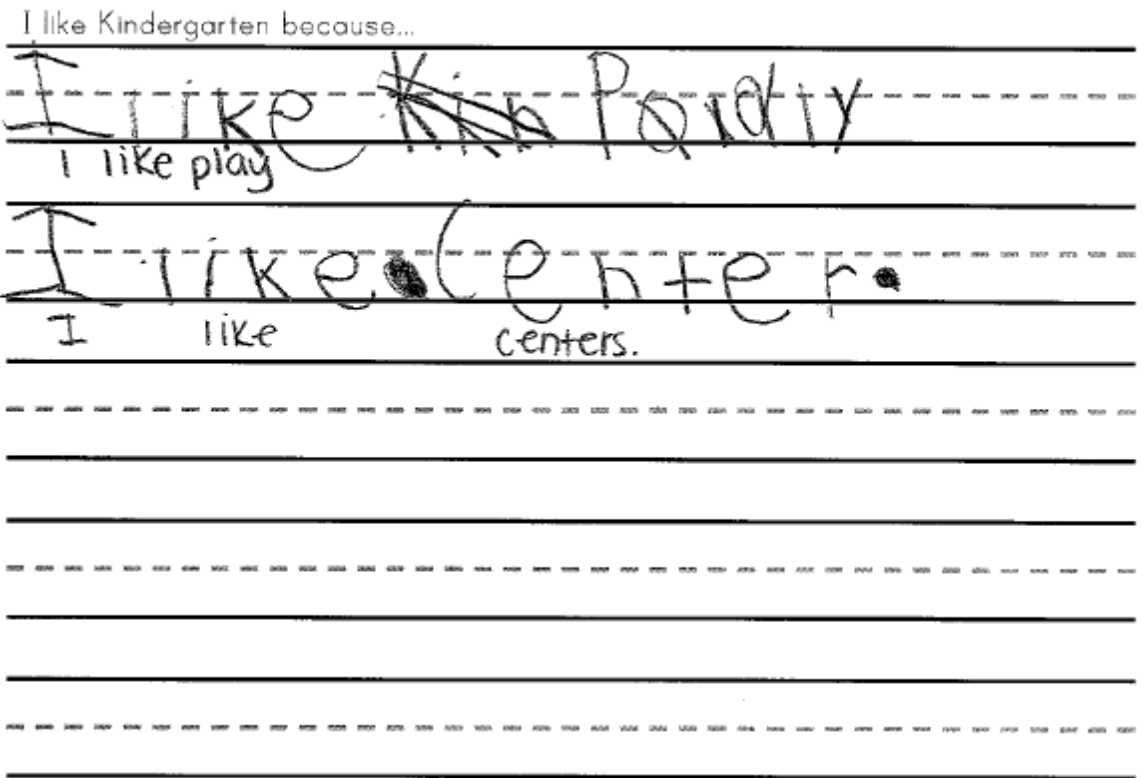


Figure 7: Essay task example at the beginning of kindergarten

APPENDIX B

CBM AT THE END OF KINDERGARTEN

This appendix provides examples of CBM collected at the end of kindergarten. All tasks were administered with the same instructions as given at the beginning of kindergarten. The first CBM (B.1) is an example of the alphabet fluency task, the second is an example of the sentence writing task (B.2), and the third is an example of the essay task (B.3). On the alphabet fluency task, stamps were no longer placed at the end of the students' writing, only at the 15 and 60-second distinctions.

B.1 ALPHABET FLUENCY TASK

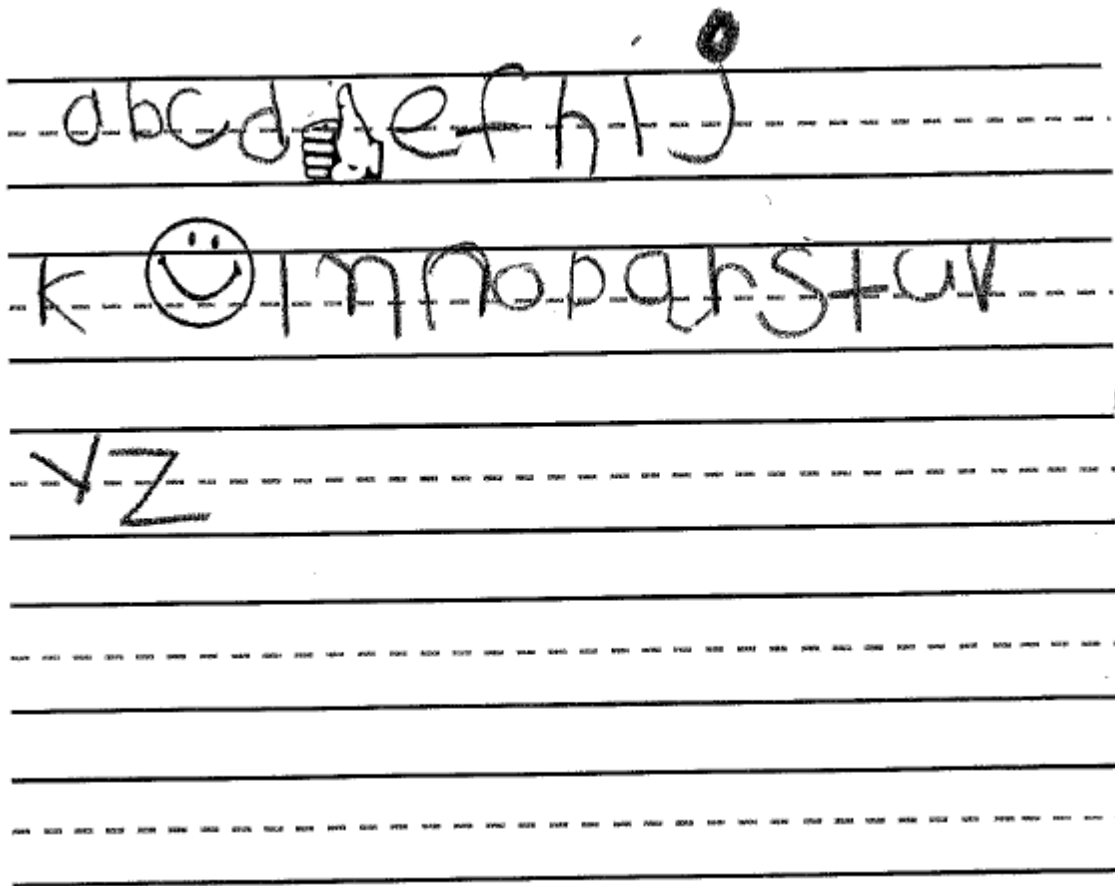




Figure 8: Alphabet fluency task example at the end of kindergarten

B.2 SENTENCE WRITING TASK



fox

I see a fox



mug

I see a mug

Figure 9: Sentence writing task example at the end of kindergarten



I can eat



I see a sock

Figure 10: Sentence writing task example (page 2) at the end of kindergarten

B.3 ESSAY TASK

I like Kindergarten because.

I like kindergarten
because i like to read
i like school is fun

Figure 11: Essay task example at the end of kindergarten

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